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Abstract. Despite the widely recognized importance of knowledge as a vital source of competitive advantage, there is little understanding of how organizations actually create and manage knowledge dynamically. We shall show that there are many different definitions of organizational learning, and hence we shall propose supplements to increase practical usability. There are differing views who actually learns; individuals, groups, organization or some other unit. We shall shed new light on this problem. We shall also show how there are differing views on possibilities to convert tacit knowledge to explicit knowledge and vice versa. The role of organizational memory in organizational learning has received differing emphasis. By presenting new ideas we try to give some help in this problem domain.

1 Introduction

According to Blackler (1995) there is current interest in the competitive advantage that knowledge may provide for organisations and in the significance of knowledge workers, organisational competencies and knowledge-intensive firms. Organisational

learning is currently the focus of considerable attention, and it is addressed by a broad range of literatures (Dodgson, 1993). Organisation theory, industrial economics, economic history, and business management and innovation studies all approach the question of how organisations learn. A number of branches of psychology are also revealing on the issue. This may partly explain a large variety in definitions of organisational learning, which we shall first analyse. One reason for that can be a contention who is learning, individuals or organisation. To this end we thereafter consider a unit of analysis.

Crossan, Lane and White (1999) concluded that although interest in organizational learning has grown dramatically in recent years, a general theory of organizational learning has remained elusive. As a tentative explanation Cook and Brown (1999) presented that much current work on organizational knowledge, intellectual capital, knowledge-creating organizations, knowledge work, and the like rests on a single, traditional understanding of the nature of knowledge. Their own view is therefore contrasted with Nonaka's (1994) model based on conversions between tacit and explicit knowledge.

We, information technology (IT) researchers, regard data bases used in administrative information systems as an essential part of organizational memory. We also consider staff as components who remember and carry information about an organization, and we are interested in to know are there any other storage bins than data bases and people. We also want to know, which processes are critical in taking care of organizational memory. Independent on whether organizational memory is located in human heads or in computer storage media, the content of organizational memory is an important resource with similarities and differences compared with other resources.

2 Definitions

In order to describe organizational learning we shall first analyze some definitions of that construct. We selected four questions Who learns? How do they learn? When do they learn? Why do they learn? from Huysman's (2000) paper where she studied various assumptions within most of the writings on organizational learning. By posing who, how, when and why questions while reviewing the definitions, we show the aspects mostly emphasized.

Argyris (1977) defined *organizational learning* is a process of detecting and correcting error. Error is for our purposes any feature of knowledge or knowing that inhibits learning. When the process enables the organization to carry on its present policies or achieve its objectives, the process may be called single loop learning. Single loop learning can be compared with a thermostat that learns when it is too hot or too cold and then turns the heat on or off. The thermostat is able to perform this task because it can receive information (the temperature of the room) and therefore take corrective action.

If the thermostat could question itself about whether it should be set at 21 centigrades, it would be capable not only of detecting error but of questioning the underlying policies and goals as well as own program. That is a second and more comprehensive inquiry; hence it might be called double loop learning. When the plant managers and marketing people were detecting and attempting to correct error in order to manufacture Product X, that was single loop learning. When they began to confront the question whether Product X should be manufactured, that was double loop learning, because they were now questioning underlying organization policies and objectives.

Argyris first emphasized *why* does an organization learn and later *when* does it learn by differentiating the two known categories of (single and double loop) learning needed.

Huber (1991) defines learning as follows: An entity learns if, through its processing of information, the range of its potential behaviors is changed. This definition holds whether the entity is a human or other animal, a group, an organization, an industry, or a society. The information processing can involve acquiring, distributing or interpreting information. (The words information and knowledge will be used interchangeable in Huber's (1991) paper.) The knowledge acquisition construct is portrayed here as consisting of five subconstructs or subprocesses: (1) drawing on knowledge available at the organization's birth, (2) learning from experience, (3) learning by observing other organizations, (4) grafting on to itself components that possess knowledge needed but not possessed by the organization, and (5) noticing or searching for information about the organization's environment and performance.

Concerning questions who, how, when and why and Huber's definition we can find that Huber diplomatically replies to the *who* question an entity, does not give any replies to the how and when questions and emphasizes improvement to the *why* question.

Dodgson (1993) describes that learning, in the sense used here, relates to firms, and encompasses both processes and outcomes. It can be described as the ways firms build, supplement and organize knowledge and routines around activities and within their cultures, and adapt and develop organizational efficiency by improving the use of the broad skills of their workforces. This broad definition incorporates a number of assumptions:

- learning generally has positive consequences even though the outcomes of learning may be negative, i.e. firms learn by making mistakes.

- although learning is based on individuals in the workforce, firms can learn *in toto*. While emphasizing the role of human agency in learning, corporate and group culture is influenced by individual learning and can assist the direction and use of that learning.

- learning occurs throughout all the activities of the firm, and, as will be argued later, it occurs at different speeds and levels. Encouraging and coordinating the variety of interactions in learning is a key organizational task.

Dodgson defines organizational learning in such a way that there are replies to all the questions: *who* (firms), *how* and *when* (throughout all the activities), and *why* (improving).

Crossan et al. (1999) developed a framework for the process of organizational learning, presenting organizational learning as four processes - intuiting, interpreting, integrating, and institutionalizing - linking the individual, group, and organizational levels. - Hence individuals, groups and the whole organization (*who*) learn, the processes *how* learning takes place are described.

Robey, Boudreau and Rose (2000) create their own definition of the main construct, *organizational learning* as an organizational process, both intentional and unintentional, enabling the acquisition of, access to, and revision of organizational memory, thereby providing direction to organizational action. They explain some key characteristics of this definition. First, they view organizational learning as an *organizational* process to distinguish it from learning that might occur at other level of social analysis, such as the individual, group or interorganizational network. Although recent treatments of organizational learning emphasize the interactions among learning at multiple levels of analysis (Crossan et al., 1999), they confine their definition to the organizational level. Second, organizational learning is a *process*, not a configuration of structural components. While prescriptions for the design of learning organizations often emphasize nonhierarchical, team-based structures, the learning process can occur within a variety of structural arrangements. Third, they consider organizational learning to be both *intentional and unintentional*. Whether guided by intended action or not, learning may occur. Fourth, their definition gives a central role to *organizational*

memory, a general term that implies that knowledge may be stored in a variety of repositories, both human and artifact (Walsh & Ungson, 1991). Organizational memory includes shared understandings of an organization's identity, the mental models that represent the organization's theories-in-use, and both cognitive and behavioral routines. Finally, they consider the organizational learning process to be undertaken to guide *organizational action*. Through acquired knowledge, an organization increases its repertoire for action.

Robey et al. (2000) very carefully restrict that an organization (*who*) learns, not individuals, groups nor interorganizational network. They define that the learning process can occur within a variety of structural arrangements (*how*), it is both intentional and unintentional (*when*) and it guides organizational action (*why*). The definition given by Robey et al. seems to best cover the dimensions given by Huysman (2000). The definition above seems to even be better than Huysman's ideal. Huysman namely found that the general literature on organizational learning represented on one side of every dimension (who - individual; how - voluntarism, when - purposeful and why - improvement) and she hence recommended the balanced view. The latter means the middle point of every dimension (individual – organization; voluntarism – determinism; purposeful – accidental; and improvement – decline).

Huysman's idea was to take two poles of one dimension. We could, however, ask whether all the aspects are one-dimensional, i.e. whether the segment of the line best corresponds to reality or do we need triangle, quadrangle, …? By taking the first aspect (who) we can ask: Does a group belong to the middle of the segment between an individual and an organization? Or does the triangle with the apices of individual, group and organization better describe organizational learning? A. Järvinen and Poikela (2001) improved the model made by Crossan et al. (1999) in such a way that the triangle view is better-grounded than the segment view.

To return back to the definition presented by Robey et al. (2000) we ranked the best one this far. It is not, however, perfect but it could be improved by adding one new dimension: *Which kind* of knowledge does an organization learn. Robey et al. discussed this topic indirectly in connection with organizational memory. By taking Argyris' differentiation of single loop and double loop learning above we can get one candidate of this new dimension. Argyris' differentiation differs from the description of organizational memory given by Robey et al. Another candidate were differentiation between declarative and procedural knowledge at work as Billett (1996) proposed. We want to offer the third candidate, too. Our proposal is based on differentiation between concrete and abstract. By concrete we in this connection mean states and events and by abstract conceptual structures or theories-in use, through which people in an

organization consider both the organization itself and its environment. The three candidates show that the fifth dimension (which kind) is possible and general, and we can in many ways differentiate it without saying anything specific about content to be learned.

3   Unit of analysis

Markus and Robey (1988) in their famous article paid attention to the importance of unit of analysis referring to the entities about which the theory poses concepts and relationships, e.g. individuals, organizations and society. Hyusman (2000) showed that in organizational learning theories an individual, not an organization, is a dominant actor who learns. But there are also differing views on the unit of analysis, and hence it is interesting to consider them, too.

Virkkunen and Kuutti (2000) suggest that in order to understand relations between different aspects of organizational learning, an appropriate unit of analysis and a concrete, historical approach is needed. They first reviewed and evaluated the unit of analysis used in representative theories of organizational learning. They then introduced "activity system", a concept that is based on Cultural Historical Activity Theory, as a potential candidate for a unit of analysis that makes it possible to analyze the specific historical, local challenges and problems of organizational learning and to direct a collective learning process.

Virkkunen and Kuutti referred to Huber's (1991) broad review on the research on organizational learning. Huber concluded that research has not been able to create any guidelines to increase the effectiveness of organizational learning. The authors criticized the community of practices (Brown & Duguid, 1991) and an organization as a knowledge production unit (Nonaka & Takeuchi, 1995). The authors use the cultural historical theory of activity. It was originally intended to describe the relationships between the individual and the society. These interactions are culturally mediated in the sense that humans use concepts and tools that the society has developed during its history. According to Virkkunen and Kuutti human beings constantly synthesize the two worlds, the directly given and the culturally mediated, to provide the mental foundations of their real-time actions in the world. New states of the subject arise from the coordination of information from the mediated and the direct connections between the subject and the object (see the upper triangle in Figure 1).

In Figure 1 the model of individual action in Figure1 has been complemented to depict the collective activity system.

Tools, signs,
symbols

Subject   Object > Outcome

Rules   Community   Division of labour
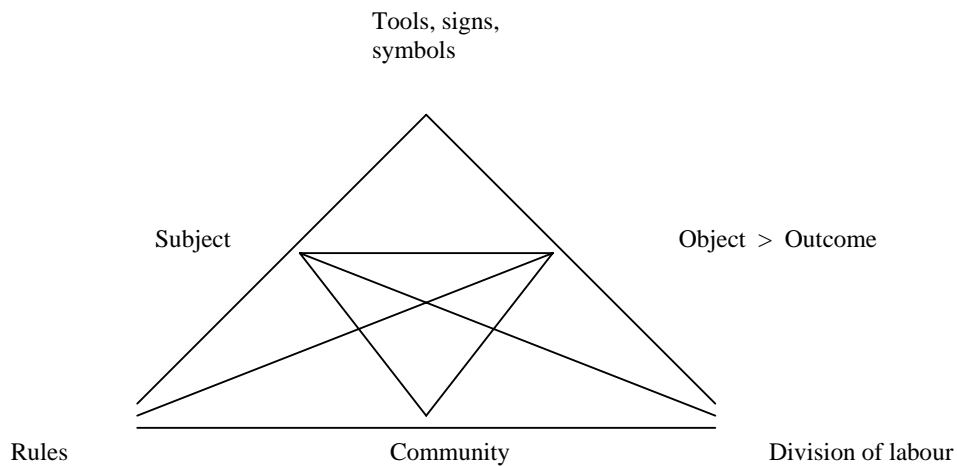
Figure 1. A general model of an activity system

The relations between the subject and the community are mediated, on one hand, by the groups' full collection of "mediating artifacts" and, on the other hand, by "rules" that specify acceptable interactions between members of the community, and "division of labour", the continuously negotiated distribution of tasks, powers and responsibilities among the participants of the activity system.

Virkkunen and Kuutti (2000) write that the key element of an activity system is the object of that activity. The object is the societal motive of the activity, it defines the activity and separates activities from each other. The object can be a material thing, but it can also be less tangible (like a plan) or totally intangible (like a common idea) as long as it can be shared for manipulation and transformation by the participants of the activity.

Virkkunen and Kuutti do not pay attention that Huber (1991) already used term entity, which can be interpreted in the similar way as activity. The advantage of an activity and an entity compared with an organization is that the former refer to a unit which is not beforehand defined as an individual or an organization but an activity and an entity can be understood situated, applicable and differing from case to case. It can concern a subgroup in the organization or a network or an alliance composed of members inside and outside of the organization. To this end we prefer an activity- and entity-type unit of analysis to the pre-defined one, as individual, group or organization.

4   From tacit knowledge to explicit knowledge?

We researchers aim to produce an explicit knowledge, which can be expressed in formal and systematic language and shared in the form of data, scientific formulae, specifications, manuals and such like It can be processed, transmitted and stored relatively easily. It is generally accepted that people also have a tacit knowledge, which is highly personal and hard to formalize. Subjective insights, intuitions and hunches fall into this category of knowledge. Tacit knowledge is deeply rooted in action, procedures, routines, commitment, ideals, values and emotions (Nonaka, Toyama & Konno, 2000). Knowledge is last years recognized as a vital source of competitive advantage, and both explicit and tacit knowledge are then wanted to be utilized. How can this be best taken place is still unclear, and hence it is important to discover differing views on both explicit and tacit knowledge and their relationships.

Nonaka (1994) claimed that organizational knowledge is created through a continuous dialogue between tacit and explicit knowledge. It is indicated that while new knowledge is developed by individuals, organizations play a critical role in articulating and amplifying that knowledge. The dialogue between tacit and explicit knowledge postulate four different modes of knowledge conversion: (1) from tacit knowledge to tacit knowledge (socialization), (2) from tacit knowledge to explicit knowledge (externalization), (3) from explicit knowledge to explicit knowledge (combination), and (4) from explicit knowledge to tacit knowledge (internalization).

	Tacit knowledge	Explicit knowledge
	to	
Tacit knowledge	Socialization	Externalization
from		
Explicit knowledge	Internalization	Combination

Figure 2. Modes of the Knowledge Creation (Nonaka, 1994)

The spiral SECI process in Figure 2 is later supplemented by *ba* and knowledge assets (Nonaka et al., 2000) in an organized way.

Cook and Brown (1999) claimed that organizations are better understood if explicit, tacit, individual and group knowledge are treated as four distinct and coequal forms of knowledge (each doing work the others cannot), and if knowledge and knowing are seen as mutually enabling (not competing). We hold that knowledge is a tool of knowing, that knowing is an aspect of our interaction with the social and physical world, and that the interplay of knowledge and knowing can generate new knowledge and new ways of knowing. Cook and Brown believe this generative dance between knowledge and knowing is a powerful source of organizational innovation.

Cook and Brown (1999) based their differentiation between *explicit and tacit* knowledge on the work of Polanyi (1983) and his example of riding a bicycle. They claimed that "it is important not to mistake using one form of knowledge as an aid in acquiring the other with one form being 'converted' into the other. Tacit knowledge cannot be turned into explicit, nor can explicit knowledge be turned into tacit".

Cook and Brown (1999) based their differentiation between *individual and group* knowledge on examples of two groups, physicians and technicians. In both cases, part of what is known about a given domain is possessed by individuals, part by groups. Individual technician and physician posses various bits of knowledge in their respective fields, but the "body of knowledge" of technology or illness is possessed by groups, not by individuals.

We can conclude that Cook and Brown's view is entirely different from Nonaka's (1994) view. We clearly need more research on this topic. Both views are based on different pre-assumptions, which can be conceptually analyzed and compared. Both theoretical formulations could also be empirically tested, although it might be difficult, because the tacit knowledge by definition is intangible. Hence an empirical test must happen in some way indirectly.

In the literature there are at least two promising ways to analyze explicit knowledge in more detail. First, Blackler (1995) presented the typology of knowledge with five classes: embodied, embedded, embrained, encultured and encoded ones. Secondly, Boland and Tenkasi (1995) presented two models of cognition (narratives and information processing) for amplifying our thinking. The dominant way of understanding cognition today is to emphasize its paradigmatic mode, as reflected in information processing models of cognition. This view of cognition emphasizing the rational analysis of data in a mental problem space and the construction of deductive

arguments, must be supplemented by recognizing that humans also have a narrative cognitive capacity. We narrativise our experiences almost continually as we recognize unusual or unexpected events and construct stories which make sense of them (cf. Brown & Duguid, 1991). To our mind, both Blacker's and Boland and Tenkasi's types classifications might give something new and important foe development of organizational knowledge.

5 Organizational memory

Walsh and Ungson (1991) argued that the extant representations of the concept of organizational memory are fragmented and underdeveloped. In developing a more coherent theory, they defined organizational memory and elaborated on its structure, and discussed the processes of information acquisition, retention, and retrieval. They based their consideration on such an theory on organization where it was viewed as an information processing system. To my mind, this means that other type of consideration is possible, if *another view on organization were taken as a starting point*.

Walsh and Ungson wrote that decision information is thought to be stored. We can ask: Is in an organization other type of information than decision information? I think that our answer is affirmative. Referring to Wand and Wang (1996) who analyzed data quality and then assumed that an (administrative) information system is a representation of a real-world system as perceived by users. This means that in addition to *decision information we have a lot of other information* in the systems describing states and events inside and outside of the organization.

Walsh and Ungson base their theory on three processes of organizational memory: acquisition, retention and retrieval. We can ask: Is the set of three processes exhaustive or *do we have a fourth process*, and which one? At least, we could *add a managing part into each process*. The acquisition process could then be purposefully planned and controlled. The latter could mean that before storing the elicited information should be checked to be valid from another sources, e.g. by using triangulation. The unwritten assumption of the retention process is that the stored information is saved unchanged and no historical information is lost. But concerning individuals and their memories that assumption is unrealistic, some historical information will change and some will be lost. The managing part of the retrieval process could control that the retrieval is

performed correctly, i.e. no changes when a stored information is moved into active use and processing.

Walsh and Ungson found five storage bins: individuals, culture, transformations, structures and ecology. We can first *supplement Walsh and Ungson's consideration* by relating those five storage bins to other classifications. If we take differentiation between *product and process*, individual, culture, structure and ecology belong to the product category and transformations into the process category. If we take *three resource types* (physical, human and informational), we locate ecology into physical resources, individuals, culture and structure into human resources and transformations (as procedures and algorithms) into informational resources.

Hargadon and Sutton (1997) describe results of an ethnographic study in the IDEO innovative product design firm. This firm exploits its network position, working for clients in at least 40 industries, to gain knowledge of existing technological solutions in various industries. It acts as a technology broker by introducing these solutions where they are not known and, in the process, creates new products that are original combinations of existing knowledge from disparate industries. Designers exploit their access to a broad range of technological solutions with organizational routines for acquiring and storing this knowledge in the organization's memory and, by making analogies between current design problems and past solutions they have seen, retrieving that knowledge to generate new solutions to design problems in other industries.

By referring to the three resource types (physical, human and informational) we can add some new storage bins. Hargadon and Sutton (1997) showed how *products and prototypes* carry information. Hence products and prototypes can be a new type of storage bin. They also showed that data and knowledge concerning projects and their outcomes can be stored into *data and knowledge bases*, which are our new proposal for a storage bin.

Hargadon and Sutton paid attention to a human role in organizational memory. At the IDEO, the storage of technological knowledge became visible only as the researchers observed the retrieval process in conversations, brainstorms, and other group problem-solving activities. From these observations, however, it was evident that much of the knowledge of potential solutions resides in the minds of the individual designers as products they had seen or used before, projects they had worked on, or technologies they had read, heard, or talked about. Observations give evidence that in the firm there are two types of routines for storing potential technological solutions:

routines for storing specific knowledge and routines for maintaining and refreshing that knowledge until it can be used.

To summarize, there are potential opportunities to improve the classification of storage bins and to present systematic argumentation for that. Another important aspect is a need for maintaining and refreshing the stored knowledge, the topic that is not yet much investigated.

6 Discussion

Our analysis of different definitions concerning organizational learning showed that there are still opportunities to improve. By adding which kind of knowledge is learned may help decision makers to direct and to focus intentional learning efforts and hence save resources. To pay attention to a proper unit of analysis in relation to organizational learning can be utilized in selecting a purposeful group for intended measures.

To notice two differing views on the tacit and explicit knowledge raises a question of validity of theoretical constructs, i.e. does a certain framework describe a domain of reality. We must organize a competition between different frameworks on organizational learning and select the one that best corresponds to the domain under consideration. We found that an organizational memory can be amended with new storage bins, e.g. products and prototypes, and maintaining and refreshing are necessary functions connected with storage bins but not yet consciously mastered. Measures to increase organizational learning will compete with other innovations for the same resources. Management must decide how to divide resources with exploration and exploitation.

We know that our conceptual analysis is only partial, because some of our claims need empirical evidence and some more through analysis of philosophical points of departure. Some of our results can, however, be immediately used as practical guidelines. We admit that the most of our proposals are only small steps forward, and we more raised new questions than gave answers. This, hopefully, will encourage us and colleagues to more study this important topic.

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